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Ensor, Jonathan Edward orcid.org/0000-0003-2402-5491, Abernethy, Kirsten, Hoddy, Eric Timothy et al. (5 more authors) (2017) Variation in perception of environmental changes in nine Solomon Islands communities : implications for securing fairness in community-based adaptation. *Regional Environmental Change*. pp. 1-13. ISSN 1436-3798

<https://doi.org/10.1007/s10113-017-1242-1>

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1 Variation in perception of environmental changes in nine Solomon
2 Islands communities: implications for securing fairness in community-
3 based adaptation
4

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32 **Abstract**

33 Community-based approaches are pursued in recognition of the need for place-based responses to
34 environmental change that integrate local understandings of risk and vulnerability. Yet the potential
35 for fair adaptation is intimately linked to how variations in perceptions of environmental change and
36 risk are treated. There is, however, little empirical evidence of the extent and nature of variations in
37 risk perception in and between multiple community settings. Here, we rely on data from 231 semi-
38 structured interviews conducted in nine communities in Western Province, Solomon Islands, to
39 statistically model differential perceptions of risk and change within and between communities.
40 Overall, people were found to be less likely to perceive environmental changes in the marine
41 environment than they were for terrestrial systems. The distance to the nearest market town (which

42 may be a proxy for exposure to commercial logging and degree of involvement with the market
43 economy) and gender had the greatest overall statistical effects on perceptions of risk. Yet, we also
44 find that significant environmental change is under reported in communities, while variations in
45 perception are not always easily related to commonly assumed fault lines of vulnerability. The
46 findings suggest that there is an urgent need for methods that engage with the drivers of
47 perceptions as part of community-based approaches. In particular, it is important to explicitly
48 account for place, complexity and diversity of environmental risk perceptions, and we reinforce calls
49 to engage seriously with underlying questions of power, culture, identity and practice that influence
50 adaptive capacity and risk perception.

51 Keywords: Adaptation, community based adaptation, fairness, risk perception, Solomon Islands,
52 climate change

53 Word count:

- 54 • number of words, counting from the top of the title page, including abstract, keywords and
55 acknowledgements to the end of text (before the reference list): 7,093 words
- 56 • number of figures and tables: 1 table, 2 figures (900 words)
- 57 • reference list: 2,819 words

58 1. Introduction

59 In circumstances where community-based approaches are prioritised as a means of environmental
60 governance, perceptions of environmental change and risk have important consequences for fair
61 adaptation. While enabling place-based adaptation actions that are appropriate to the scale of
62 environmental impacts, participatory and decentralised approaches do not automatically guarantee
63 the rights or entitlements of poor or marginalised groups (Cote and Nightingale 2012). Studies have
64 repeatedly demonstrated how underlying power relations and cultural values create a complex
65 context in which governance and management interventions can unwittingly contribute to elite
66 capture (e.g. Peet and Watts 2004). Within this, the role played by variations in perceptions of
67 change and risk has particular significance, limiting response options and curtailing the capacity to
68 adapt of marginalised or less powerful groups (Cutter et al. 2003, Cutter and Emrich 2006, Jones and
69 Boyd, 2011, Ensor et al. 2015).

70 Studies of environmental risk perception rarely focus on the “contexts and characteristics of people
71 and places” and “do not adequately account for societies and scenarios in the under-developed
72 world” (Walker et al. 2014:710). At the same time, initiatives aiming to foster adaptive responses to
73 environmental change have tended to overlook the importance of context-specific change and
74 perceptions of risk, focussing instead on a single change, and treating all communities as the same
75 (Dodman and Mitlin 2011, Bennett et al. 2015). While frequently adopted as a scale of study and
76 action, communities are not homogenous units. They can differ in their geography and natural
77 resources, types of livelihood activities and use of different environmental systems, and in their
78 sense of place, social-cultural practices, beliefs, norms, histories and politics. All of these factors
79 shape localised constructions of environmental risk and the decisions made in response (Venables et
80 al. 2012, Granderson 2014, Rodriguez-Carreras et al. 2014, Walker et al. 2014). Recent calls for more
81 empirical studies on the local nature of environmental change recognise that science and modelling
82 cannot capture these local processes and that multiple exposures unfold and are experienced
83 differently between and within communities (Bennett et al. 2014, Walker et al. 2014).

84 Community-based alternatives to top-down governance are invoked precisely to account for this
85 diversity and to harness local understandings of change (Green et al. 2010) and community-based

86 adaptation approaches in particular have received increasing attention among researchers and
87 practitioners (Ensor et al. 2016; Ensor et al. 2014; Spires et al. 2014; Forsyth 2013; Dodman and
88 Mitlin 2011). Local ecological knowledge can provide information about slow and rapid climate and
89 ecological changes at the community level (Sagarin and Micheli 2001, Couzin 2007, Alexander et al.
90 2011), and also play an important role in defining the way environmental change is interpreted and
91 understood as risk (Adger et al. 2013, Brook and McLachlan 2008, Naess 2013, Aswani and Lauer
92 2014). Yet as studies of adaptive capacity have revealed, social, historical, political and institutional
93 variations within and between communities can determine the distribution of benefits and costs
94 that flow from community-based approaches (Ensor et al. 2015). Differences in perception of
95 environmental change and risk interact with these variations, adding to the challenge of developing
96 community-based approaches that are both fair and effective.

97 In this paper, we illustrate that variability in perceptions of risk and change reveals important
98 avenues of enquiry for research and practice if community-based adaptation is to be both equitable
99 and effective. Our study focuses on perceptions of multiple environmental changes and risks among
100 resource-dependent coastal communities in Solomon Islands. We examine six locally recognised,
101 major environmental and resource systems relevant to the livelihoods of coastal communities.
102 During fieldwork, community respondents were asked to describe changes they had perceived or
103 observed in their lifetime across these systems. Based on these data, individual differences in
104 perceptions of change and risk were investigated in nine communities by combining a detailed
105 household survey with a systematic ethnographic interviewing process. The survey data were
106 analysed statistically to assess how perceived changes depend on characteristics of each respondent.
107 Our approach shows that different groups perceive environmental risks differently, within and
108 between communities.

109 In the Pacific context, it is widely recognised that cultural and spiritual values, individual experiences,
110 and traditional resource management practices have significant implications for perceptions of risk
111 and the ability to adapt (Granderson 2017, Warrick 2016, Weir 2016, Nunn et al. 2016a; Mortreux
112 2009). These factors can vary significantly between communities and across scales, leading to calls
113 for adaptive approaches to be pursued at the community scale. Participation of communities can
114 support the development of culturally appropriate responses to environmental change that
115 acknowledge the significance of spirituality and sense of place in natural resource management
116 decision-making, while supporting traditional decision-making structures to respond to the pace and
117 complexity of contemporary challenges (Nunn 2014; Nunn et al. 2016b, Buggy and McNamara 2015).
118 Crucially, community-based and participatory approaches are seen as a strategy to draw in the
119 extensive ecological and biocultural knowledge which is found on Pacific small islands, and which has
120 underpinned localised resilience and adaptability (McMillen 2014; Remling and Veitayaki, 2016). Yet,
121 despite this tradition of resilience, the need to understand how best to support effective
122 community-based responses is all the more essential in the Pacific, where climate variability and
123 extremes are common yet the processes that lead to climate change are often not recognised at the
124 local level (Weir 2016, Nunn 2014; Remling and Veitayaki, 2016).

125 The next section reviews the literature on perceptions of environmental change and risk. We then
126 provide a brief background to the environmental systems and communities where the surveys were
127 conducted. The mixed methods approach is summarised in the subsequent section. Since the focus
128 of this paper is on the qualitative implications of the findings, we refer readers to the electronic
129 supplementary material for more detailed information about the statistical analysis. We present our
130 findings and discuss how this may affect small coastal communities' localised responses to
131 environmental change. In so doing, we hope to reveal the complexity of the community as a venue

132 for development practitioners working to foster collective community-based responses and fair
133 adaptation to ongoing environmental changes.

134 2. Perceptions of environmental risk and change

135 Perceptions of change and risk are shaped by people's everyday lives and what they do, their social
136 and political-economic settings and their relationships and networks (Kurrupu and Liverman 2011,
137 Wolf and Moser 2011, Walker et al. 2014). Social hierarchies such as gender may also shape
138 perceptions of change and risk insofar as these designate people's place and power in communities,
139 and shape their livelihood practices and access to resources (Lebel et al. 2017, Bee 2016, Razavi
140 2009, Cole et al. 2014, Sarapura and Puskur 2014). Identity has been found relevant in shaping
141 perceptions of change and risk (Frank et al. 2011; Wester-Herber 2004). Frank et al. (2011) illustrate
142 how farmers might perceive risk through an identity lens, "such that farmers' perception of
143 themselves in relation to others shapes how they interpret threats to their wellbeing and
144 livelihoods" (Frank et al. 2011: 75). Identity is often interlinked with sense of place, which itself may
145 mediate the way change and risks are understood (Fresque-Baxter and Armitage 2012, Rodríguez-
146 Carreras et al. 2014, Sachdeva 2016). Granderson (2014) argues for greater engagement with the
147 interpretive social sciences in offering a more holistic account of risk. She suggests risk is bound up in
148 people's "shared values and worldviews, their sense of place, justice and accountability, discourses
149 and power, deeply enmeshed in the cultural and political processes at the community level"
150 (Granderson 2014: 59). Such perspectives draw attention to the limitations of assuming risk
151 assessment by individuals, communities and groups as a straightforward responsive pathway to
152 action, and that the various barriers to adaptation and behavioural change intervene only after risk
153 is appraised or constructed (Grunblatt and Alessa 2017, Stern 2016, Grothman and Patt 2005, Tucker
154 et al. 2010, Gifford et al. 2011, Adger et al. 2013).

155 Perspectives informed by psychological theory have drawn attention to how cognition and emotion
156 lead to systematic biases in how people appraise risk, how they perceive their own capacity to
157 respond, and weigh up the costs and benefits of action (Slovic 1987, Grothman and Patt, 2005,
158 Breakwell 2010, Granderson 2014, Frank et al. 2011). Alongside material and structural barriers to
159 adaptive responses (and ignorance of a problem), much has been written about limited cognition,
160 and how it can create "dragons of inaction" (Gifford 2011). These include 'environmental numbness'
161 (Gifford 2011, p.292) when there are too many cues to monitor, valuing the present while
162 undervaluing distant risks, scepticism and uncertainty about change, external locus of control,
163 cognitive dissonance and denial (Kollmuss and Agyeman 2002, Feygina et al. 2010, Gifford et al.
164 2011, Morton et al. 2011, Smith et al. 2011, Whitmarsh 2011, Navarro 2017).

165 While urgent, the complexity associated with risk perception should give reasons for adaptation
166 practice to be cautious. Efforts at community-based decision-making may become unfair through
167 elite capture or the marginalisation of the perspectives held by those who are least powerful.
168 Framings of perceptions of risk by more dominant groups may prevail or go unchallenged (e.g. local
169 elites who speak for community members, or community members that reproduce elite discourses),
170 leading to exclusion of groups (and their knowledge or values) based on hierarchies of gender, age,
171 ethnicity, religion and socio-economic position that are reinforced through norms and practices of
172 decision making (Dodman and Mitlin 2011; Cote and Nightingale 2012). Moreover, heterogeneity in
173 social-cultural backgrounds and perceptions make community-based collective action challenging
174 (Varughese and Ostrom 2001). Pluralism in experiences and perceptions of environmental change
175 and their risks within communities may raise tensions in aligning constructions of risk and enabling
176 collective responses. Intra-community differences in perceived changes may lead to uncertainty

177 which may reduce the intention to act, increase individualism (Morton et al. 2011), and increase
178 conflict (Rodriguez-Carrera et al. 2014).

179 In examining justice dilemmas in adaptation to climate change, Paavola and Adger (2006: 594)
180 conclude that fair adaptation requires “putting the most vulnerable first and equal participation of
181 all”. The community scale has been identified as an appropriate venue for fair adaptation, as
182 participatory methods can be used to engage with the poor and vulnerable, resulting in a form of
183 adaptation that is “more attuned to local needs, and consequently better able to reduce
184 vulnerability to climate change” (Forsyth 2013). Community-based adaptation to environmental
185 change (CBA) focuses on “a community-led process, based on communities’ priorities, needs,
186 knowledge and capacities” (Reid et al. 2009: 13) that requires practitioners to explore climate and
187 environmental change impacts and responses in partnership with communities, drawing out local
188 knowledge and understanding of the complex relationship between environmental hazards and
189 livelihoods (Pringle and Conway, 2012). Community perceptions are relied on to identify local
190 manifestations of environmental change. However, the complexity of this task is often
191 underestimated in the existing literature. For example, a critical examination of perception is absent
192 in a review of literature that focus on the challenges to CBA (Forsyth 2013, Spires et al. 2014),
193 despite agreement that “[e]xisting knowledge and experience of changes within communities need
194 to be acknowledged as starting points for opening up conversations about adaptation.” (Spires et al.
195 2014: 9). Critical engagement with the underlying social and cultural dynamics at play in risk
196 perception is essential if the central role of local knowledge in community-based adaptation is to
197 yield the presumed benefits for equity in adaptation processes and outcomes.

198
199 In the following study we focus on the perceptions of risks and environmental change among
200 different social groups in different communities in Solomon Islands, investigating the extent and
201 nature of variations in perception in and between village settings. In so doing we illustrate the highly
202 differentiated assessments of risk that community-based adaptation must account for, and reinforce
203 calls for adaptation to engage seriously with underlying questions of power, culture, identity and
204 practice that inform adaptive capacity and risk perception, and cut across communities and localities
205 in often unexpected ways.

206 3. Background

207 This article draws on a study that was carried out in nine villages across Western Province of
208 Solomon Islands, including in Roviana (Nusa Hope, Kindu, Nusa Banga, Olive) and Vonavona lagoons
209 (Kinda), Marovo lagoon (Niniveh, Bopo, Bareho), and Vella Lavella Island (Leona) (Figure 1). Lagoon
210 systems are extensive in Western Province and comprise diverse socio-ecological systems. Marovo
211 lagoon in the southeast consists of small islands and a raised double barrier reef (Albert et al. 2007).
212 It is rich in biodiversity and is the largest saltwater lagoon in the world covering some 700 km²
213 (Hviding 2005). Roviana and Vonavona lagoons are located in South New Georgia of the Western
214 Province. The Roviana lagoon is shallow, approximately 50 km long, and enclosed by raised coral reef
215 islands between 2-3 km offshore (Hamilton and Walter 1999). Vonavona lagoon is smaller than
216 Roviana and has a somewhat different topography.

217 The sense of identity among Western Province inhabitants is strongly connected to the multiple
218 cultural groups that inhabit the islands, their shared church community, and inherited chiefly system
219 that govern a community’s land and sea resources (Aswani et al. 2015, Bennet et al. 2015). The
220 islands are home to around 77,000 people speaking up to 16 major languages, 8 of which are found
221 on South New Georgia (Bennet et al. 2015, Hamilton and Walter 1999). The Roviana lagoon is
222 unusual in being populated by closely related tribal groups who speak a common language in

223 multiple villages along the mainland and barrier island (Hamilton and Walter 1999). The common
224 language (Roviana) is also spoken in Vonavona, while the more distant populations inhabiting Vella
225 Lavella island and Marovo lagoon belong to different language groups (Bennet et al. 2015). Vella
226 Lavella Island is located west of New Georgia, near Ghizo, and the communities here are coastal,
227 exploiting very different land- and seascapes to those living on the lagoons. All the communities in
228 the study area are of Melanesia descent, distinguishing them from Gilbertese communities whose
229 members are Micronesian immigrants brought to the Solomon Islands during the 1960s by the
230 British colonial government. A detailed ethnographic discussion of the communities in this study can
231 be found in Aswani et al. (2017a).

232

233 **Figure 1. here**

234 Across the sites, community leaders exercise control over the use of and access to natural resources
235 within their particular customary land and sea territories, although changing demographic and
236 consumption patterns coupled with large-scale resource extraction ventures are increasingly eroding
237 these customary systems. In particular, the economy of the Solomon Islands has long relied on
238 logging royalties based on extraction at up to five times the sustainable rate. Corruption,
239 mismanagement, failures of regulation and enforcement, and mistrust among tribal groups have all
240 combined to mean that the benefits of logging have not been felt at the community level. Rather,
241 the industry has driven habitat loss, landslides, erosion and watershed damage, undermining local
242 livelihoods, access to nutrition and women's control over resources (Waters and Lyons 2016). The
243 subsistence economy still plays a central role in the life of people in Western Province, but some
244 livelihood activities, such as coral collection for building materials, fishing pressure, and
245 sedimentation from poor land practices and logging are negatively affecting the lagoon and coral
246 reef systems. There are temporary and permanent marine closures throughout the sites, selected in
247 response to declining marine resources, and to conform to local socio-cultural (e.g. death and
248 feasting) and economic realities (e.g. need for case for school fees). The 'success' of community-
249 governed closures has been dynamic and varied, due to political, religious, leadership and tenure
250 disputes, and competing priorities. Hence some closures have been socially and biologically
251 successful while others have not (Aswani et al. 2017b).

252

253 **3.1 Methods**

254 Fieldwork concentrated on six locally recognised, major environmental and resource systems
255 relevant to the livelihoods of coastal communities in western Solomon Islands. These included: open
256 sea (ocean outside the lagoons and coral reefs); outer reef (outside lagoons, and intertidal zone of
257 the barrier islands), lagoon (pools, channels, shallow and mid-depth coral reefs and reef drops),
258 terrestrial (non-agricultural ecosystems such as forests and mangrove), agriculture (plots and
259 gardens), and weather. A total of 231 semi-structured interviews were conducted across the nine
260 villages in 2011 in the local 'lingua franca' known as Solomon Islands Pijin. The project leader and
261 team were aware that for some Pijin would not be the language they are most familiar with. The risk
262 that this could be exclusionary was ameliorated as the leader and team were people local to the
263 region with extensive experience working with the majority of these villages for over two decades.
264 Interviews (50 per village; 25-60 years old and not from the same household) were conducted one-
265 to-one using techniques to encourage less confident participants (women and youth). Respondents
266 were selected from across age ranges identified as important life stages. Overall, 40% of
267 respondents were female and the mean age of respondents was 43 (SD ± 12) years. It is important to

268 note here that our sample was purposive, and generalisations beyond the communities at the sites
269 are limited.

270 Respondents were asked to describe and list the changes they had perceived or observed in their
271 lifetime across the six environmental and climatic systems. A 'free-listing' approach was used
272 (Bernard 2011), where respondents were asked to spontaneously list as many perceived changes as
273 they could for each system. The goal was to identify locally significant definitions and examples of
274 change. An assumption was made that the first responses were the most important and relevant
275 change recognised by the respondents. Questions were asked about perceptions of change rather
276 than perceptions of risk to allow for responses to be either negative or positive, and because the
277 term 'risk' can have "multiple rationalities, imaginaries and practices attached to it" (Granderson
278 2014). To account for risk, a follow up question was asked about whether the change was
279 considered to be a problem or an opportunity. However, between 95-100% of changes were classed
280 as problems in each system (open sea = 97.3%, outer reef = 100%, lagoon = 100%, terrestrial =
281 94.9%, agriculture = 98.9%, weather = 97.7%). Changes were each coded into a common set of
282 responses.

283 Data were collected on the characteristics of individual respondents, including their age, educational
284 level, and gender, so that it could be determined statistically whether these characteristics affected
285 the changes each person perceived. Further details about these characteristics can be found in the
286 Electronic Supplementary Material (ESM) at Appendix 1. These data were then used to build
287 multinomial logit models (MLMs) to examine differential perceptions of change within and between
288 the communities and their systems. Each environmental system was modelled separately, resulting
289 in six final models that are presented in the results section and in appendix 4 and 5. MLMs were
290 selected because they are capable of assessing how perceived changes depend simultaneously on
291 functions of multiple variables (in our case, the respondents' characteristics) (e.g. Croissant 2012).
292 The results in the following section are therefore presented in terms of the probability (generated by
293 the MLMs) that a particular respondent will perceive a particular change (for example, the
294 probability that a male respondent would perceive 'no change' in their environmental and resource
295 system). Moreover, additional variables can be considered, allowing exploration of, for example, the
296 probability that a male respondent would perceive 'no change' in their environmental and resource
297 system at different distances from a market town. In each case, the probability is model-generated
298 (by the MLM). Additional information about the statistical analysis can be found in the ESM at
299 Appendix 2.

300

301 4. Results

302 The results of all MLMs are summarised in Table 1. In the table, the top 3 changes for each system
303 are shown and the probability of perceived changes identified according to gender, distance to
304 market town and so on. As Figure 2 illustrates, the visual analysis of the models provides a more
305 detailed analysis of the effect of the multiple variables. In the following, the open sea system is
306 analysed via Figure 2 and a narrative description of findings. In the interests of brevity, the
307 remainder of the results are presented in terms of a narrative description only, with visual analysis
308 similar to Figure 2 available for each system in the electronic supplementary material at Appendix 4
309 of the ESM. The detailed statistical output for each model is available at Appendix 5 (ESM).

310 **Table 1 here.**

311 For the open sea system, only gender and distance to market town were statistically significant. The
312 detailed impact of these variables is shown in Figure 2 and the detailed statistical output in Appendix

313 5 (see ESM Appendix 5, Table 5). Neither age, nor educational level influenced any of the responses
314 from research participants. As Figure 2 illustrates, males were more likely to have perceived change
315 than females, who were much more likely to offer a “no change” response. Distance to market town
316 had a substantial influence on choice, and, as the distance from the market increased for each
317 village, both men and women were more likely to report having seen a change. The largest change
318 reported by men was that there were “less fish or that fishing was more difficult”. The probability of
319 men saying they had seen this change increased the further away from market they lived. The other
320 important change that men reported having seen was that “currents were getting stronger”. The
321 probability that men reported this also increased with distance to market town.

322 **Figure 2 here.**

323 In the outer reef system model, only gender was statistically significant (see ESM Appendix 4 Figure
324 4 and Appendix 5 Table 6). Women were more likely to say there had been “no change” than men.
325 Men considered “habitat damage” to be the next most important change, followed by “less
326 fishing/fishing more difficult” while these two observed changes were reversed among the female
327 respondents.

328 In the lagoon system, only years of education and distance to market were statistically significant
329 (ESM Appendix 5 Table 7), age and gender having little discernible effect. Greater distances to
330 market towns made people more likely to say there had been “no change” in the lagoon. The
331 interviewees were also more likely to say there had been “no change” if they had had less education.
332 More varied reasons were cited for change in the lagoon than in the other systems examined. The
333 two main reasons for change examined in this system (“dirtier/more turbid water” and “less
334 fish/fishing was more difficult”) were both relatively rarely cited (~ 10%), and the probabilities that
335 these would be chosen diminished with distance to market.

336 In the terrestrial (land ecology) system, the most appropriate model included distance to market
337 town, gender and education level (ESM Appendix 5 Table 8). The age of the respondent did not
338 significantly affect perceptions. “No change” was the most frequently selected. Women were more
339 likely to say there had been “no change” than men. Similarly, people with less education were
340 slightly more likely to say there had been “no change”. The most likely change reported was that
341 there was “less vegetation” and women were slightly more likely to say this, as were people who
342 lived further away from the market town. The other common change reported was that “logging had
343 been introduced”. There was little effect of gender on this, but people who lived closer to the
344 market town were more likely to give this response.

345 In the agricultural practices system, occupation (i.e., whether the respondent identified him/herself
346 as a fisher or not) and educational level were the only significant variables influencing perception of
347 change (ESM Appendix 5 Table 9). Neither gender, nor distance to market had any significant effect
348 on choice and it should also be noted that in this system very few changes were noted by the
349 respondents overall in comparison to the other systems we examined (ESM Appendix 3 Table 4).
350 Those who identified themselves as fishers were more likely to say there had been “no change” than
351 people who did not fish. Also, those with more education were also more likely to say there had
352 been “no change” to agriculture. The most common response for both educational levels was that
353 crops were “less productive”, and this was affected only weakly by type of employment. The other
354 most common response was that there were “more pests” in agricultural systems. Non-fishers and
355 those with more education were slightly more likely to give this response.

356 For the weather system, the only statistically significant predictor was distance to market (ESM
357 Appendix 5 Table 10): age, gender, employment, and educational level all made no difference. The
358 most likely changes in weather that people reported were that there was “more rain”, and that
359 “seasons had become more unpredictable”. People who lived further away from the market town
360 were much more likely to say there was “more rain” nowadays, and less likely to say that “seasons
361 were more unpredictable”.

362 5. Discussion

363 This study has documented the local perceptions of environmental change in small resource-
364 dependent coastal communities of Solomon Islands. The aim has been to contribute empirical
365 research and respond to calls for more studies on the local nature of environmental change, and
366 how changes may be perceived differently across communities and among individuals who vary in
367 geography, livelihood activities and social-cultural practices (Bennett et al. 2014, Walker et al. 2014).
368 Interestingly, environmental changes in Western Province were not readily perceived, particularly in
369 marine systems, and perceptions of environmental risk in the different environmental systems were
370 unevenly distributed between and within communities. These findings in turn give rise to questions
371 about the underlying patterns of power, culture and identity, which we explore in the section below.
372 We then follow with a discussion of what these findings mean for community-based and ‘fair’
373 adaptive responses.

374 **5.1. Empirical findings**

375 People of western Solomon Islands were more likely to perceive environmental changes in the
376 terrestrial and agricultural environment and with weather patterns than they were for the marine
377 environment systems (open sea, outer reef and lagoon). When changes in the marine systems were
378 perceived, the variety of changes described by people was greater than for the other systems. The
379 most commonly perceived change in all three marine systems in this study was reduced fish catches,
380 yet only 20% of people gave this response. This is unexpected given documented fish declines, the
381 high dependence on and use of the sea, and the detailed and rich knowledge of the marine
382 environment and sophisticated social-ecological habitat classification systems in the communities
383 studied (Lauer and Aswani 2010). In a practical sense, changes in marine environments are less
384 visible than terrestrial environments, but change may also be masked or explained by environmental
385 variability which is not perceived as a risk (Green et al. 2010). The marine ecosystems of Solomon
386 Islands have been shown to be resilient, absorb impacts and rapidly recover from ecological
387 disturbance (Lauer and Aswani 2010, Lauer et al. 2013).

388 There are multiple potential explanations for this widespread failure to recognise changes in marine
389 resources. In general, people are not very good at perceiving slow and incremental changes
390 (Kollmuss and Argyman 2010), often referred to as ‘shifting baselines’ which ‘normalise’ the
391 environmental changes that are occurring (Pauly 1995, Saenz-Arroyo et al. 2005, Pinnegar and
392 Engelhard 2008, Turvey et al. 2010). This may be compounded by changes in fishing practices and
393 ‘effort creep’ as fishers are travelling to more distant fishing grounds and spending longer fishing
394 (Albert et al. 2015), and there have been marked improvements in gear technology (Lauer and
395 Aswani 2010). Cultural practices may also be relevant here. Communities can attribute variations in
396 catches in the region to magic or charms which bestow success or unluckiness, possibly affecting the
397 way risk is appraised. Variation in catch may also be explained by one’s social behaviour, or the
398 behaviour of relatives, especially female kin. While there is a widely-held assumption that those
399 people who depend on the environment and live a subsistence lifestyle will readily observe
400 environmental change, this has been shown not to always be the case (Green et al. 2010, Kurrupu
401 and Liverman, 2011). These findings give further weight to this alternative narrative of local

402 knowledge of livelihoods resources, suggesting a need for further research effort to both understand
403 the driving forces of risk perception and to build a more realistic picture of the potential for local
404 knowledge to inform community-based adaptation.

405 People's perceptions of environmental change were quite strongly affected by the community they
406 lived in, specifically the distance their community was to the nearest market town. It was expected
407 that people's perceptions would differ across communities as the use of environments and threats
408 to environments differ (Kurrupu and Liverman 2011, Rodriguez-Carreras et al. 2014). Distance to
409 market town was a significant explanatory variable for four of the six environmental systems; the
410 open sea, lagoon, terrestrial and weather systems. People who lived far from town were much more
411 likely to have perceived a change in the open sea (less fish and stronger currents), but had observed
412 little change in the lagoon. In contrast, people living close to town were more likely to have said they
413 had seen changes in the lagoon (less fish or dirty water). People close to town perceived the greatest
414 change in the terrestrial system to be the introduction of commercial logging (compared to those far
415 away who perceived less vegetation as the greatest change), which may indicate the localisation of
416 the industry around urban centres, its contribution to urban economies and/or its drawing on local
417 labour. This suggests that "distance to market" is a proxy for, among other factors, proximity to
418 and/or involvement in commercial logging. However, it should be noted that logging is generally a
419 transitory phenomenon, which may last up to a decade, while the market town remains. Elsewhere
420 in the Pacific, distance to market has also been shown to be an important predictor for prevalence of
421 highly extractive fishing practices, suggesting a wider socioeconomic significance for markets in the
422 region (Cinner 2005; Cinner and McClanahan 2006). This points to the importance of investigating
423 place and the character of local political ecologies in future studies that aim to understand the way
424 change and risk is perceived (Rogan et al. 2005; Davenport and Anderson 2005).

425 There was high variation in environmental perceptions within communities. The largest documented
426 distinction in livelihoods within subsistence communities in Solomon Islands is between men and
427 women (Weeratunge et al. 2011) so unsurprisingly gender was the greatest (statistical) intra-
428 community variable influencing what people say about environmental change. This finding is
429 consistent with theoretical work and empirical studies that have identified the gendered perceptions
430 of change and risk (Gustafson 1998; O'Connor et al. 1999; Combest-Friedman 2012; Tyler and
431 Fairbrother 2013; Wright 2014, Lebel et al. 2017, Bee 2016). Women were less likely to perceive
432 changes in the marine systems outside the lagoon (the open sea and outer reef) but just as likely as
433 men to perceive changes within the lagoon. It is commonly held by government fishery officers that
434 men 'fish' and women 'glean' (for invertebrates), and the national statistics show 90% of men and
435 50% of women are engaged in fishing (JICA 2010). However, there are significant variations between
436 provinces and communities (Ramofafia et al. 2007, Prange et al. 2009; Boso and Schwarz 2009). In
437 the lagoons of Western Province (our study site), women are avid fishers. They are reputed for their
438 fishing skills and would be just as likely as men to perceive changes. However, outside the lagoon,
439 fishing is 'big game' and the domain of men (Aswani 2014). The statistical data on men and women's
440 perceptions or concerns is thus consistent with their degree of practical engagement in particular
441 livelihood activities.

442 In the agriculture system both men and women tend gardens, but women do most of the
443 agricultural work (Weeratunge et al. 2011, Kruijssen et al. 2013). In contrast to the coastal system,
444 where gendered livelihood practices correlate with gendered risk perception, men and women in
445 the terrestrial system have similar risk perceptions. This warns against simplistic assumptions of a
446 relation between the gendered character of environmental knowledge and risk on the one hand,
447 and the livelihood practices of men and women on the other. The social and cultural norms that set

448 out the place of men and women in livelihood practices are underpinned by power relations in the
449 household as well in communities and society as a whole (McKinnon et al. 2016, Cote and
450 Nightingale 2012), shaping who has access to and control over resources, knowledge and discourses,
451 and thus likely affecting how environmental change is perceived and by whom. For example, in this
452 case, domestic institutions may be at play in mediating gendered knowledge, resulting in shared of
453 perceptions of change and risk around (shared) gardening activities. Thus, institutional relations and
454 the deep rooted social and cultural norms that inform and are reinforced by them, need to be
455 explored alongside more readily observable characteristics of gender and livelihood.

456 **5.2. Fair adaptation**

457 Securing fairness through a focus on vulnerability and participation in communities means
458 recognising that adaptation unfolds in complex social settings. Social and cultural relationships,
459 embedded in the transactions that shape everyday life, and often overlaid on discriminatory or
460 poorly resourced state services, entrench differences in people's capacity to adapt, within and
461 between communities (Ensor et al. 2015). Our findings illustrate further complications that arise due
462 to variations in perceptions of change within and between groups that are differently situated in
463 social, cultural and political terms (Kurrupu and Liverman 2011, Wolf and Moser 2011, Walker et al.
464 2014). Evidence from our study therefore supports existing research that argues for the significance
465 of perception in adaptation (Walker et al. 2014, Granderson 2014; Bee 2016). We draw attention to
466 the role that may be played by deep rooted social and cultural norms, informed and reinforced by
467 institutional relations, in determining when and why risks are perceived as significant and how they
468 are acted on (Granderson 2017, Warrick 2016, Weir 2016, Nunn et al. 2016a; Mortreux 2009).
469 Examining these in context is best pursued through qualitative inquiry. The challenge for those
470 supporting community based approaches is therefore considerable: while the interests of fairness
471 suggest it is necessary to surface the underlying causes of patterns of perception, the process of so
472 doing may reveal or lead to greater heterogeneity in perception within a community setting. This, in
473 turn, may raise tensions within communities, increase uncertainty, and reduce the potential for the
474 forms of collective action necessary for community-based adaptations to be enacted (Varughese and
475 Ostrom 2001; Rodriguez-Carrera et al. 2014). Effective community dispute resolution mechanisms
476 can reduce this risk to collective action, but are absent in the study area (Aswani et al. 2017).

477
478 The subtle processes through which risks are normalised or prioritised according to social, cultural or
479 political influences are not accounted for when CBA focuses on participation in terms of
480 representation and voice. In our results, this problem is illustrated where communities apparently
481 fail to perceive the effects of environmental change. If environmental change is going unnoticed
482 when it is incremental and/or occurring in communities with a strong sense of place, then CBA's
483 reliance on local experiences of change as a measure of the risk is called into question. Further, how
484 and when gender similarities or differences in risk perception arise (for example, in relation to
485 agricultural systems) must be disentangled, to establish whether they are due to similar experiences
486 of change, or a reflection of underlying community power dynamics. Failure to do so may undermine
487 efforts that are intended to deliver fairness, such as through prioritisation of the risks expressed by
488 the most vulnerable groups such as women. Simple inclusion, through the introduction of
489 participatory processes, may well not be enough overcome deep rooted patterns of marginalisation
490 (Cote and Nightingale 2012). Relations of power, when embedded in formal regulations, social and
491 cultural norms and everyday practices may inform and reinforce gender (or other) identities while
492 simultaneously driving marginalisation and exclusion. Supporting fairness and social equity in such
493 situations demands intensive development approaches that attend to empowerment, self-reflection
494 and Freirean 'conscientization' (Freire 1970; see for example Dyer 2017 on gender roles and

495 empowerment approaches in Solomon Islands). This is significant not least because such approaches
496 are unusual within CBA (Ensor 2014; Dodman and Mitlin 2011).

497 The results of our study reveal how risk perceptions can vary significantly within and between small
498 communities that exist within a relatively small locale. Overall, perceived environmental change may
499 be grounded in practical, cognitive and/or social-cultural factors, and it may be related to a lack of or
500 denial of perceived risk to livelihoods (Gifford 2011, Smith et al. 2011). In this context, survey data
501 alone is insufficient for identifying local changes that lead to designing adaptation pathways. Mixed
502 methods, including ethnographic and ecological techniques, may be required to reveal the complex
503 relationships between change, risk and how perceptions are formed, and to disentangle
504 environmental variability, shifting baselines and discourses (Ensor et al. 2016). Such an approach
505 would go beyond vulnerability and risk assessment methods currently prevalent in the Pacific region
506 (Hay and Mimura 2013). The observed intra-community variability, particularly between men and
507 women, support the view that communities cannot be assumed to be homogenous in perception
508 (Kurrupu and Liverman 2011, Wolf and Moser 2011, Walker et al. 2014) any more than they are in
509 power (Agrawal and Gibson 1999, Kumar 2005, Dodman and Mitlin 2011, Forsyth 2013). Yet, as
510 Dodman and Mitlin (2011) note, there is a tendency for intra-community variability to be ignored
511 when the focus of participatory development is firmly on the 'community'. Intra- and local inter-
512 community differences in perception need to be appreciated as part of this picture, with
513 consequences for the design of CBA processes that seek to account for heterogeneity.

514 6. Conclusion

515 The findings reported here contribute empirical data from Solomon Islands to a growing literature
516 that emphasises the significance of perception in experiences of environmental risk and change. In
517 Solomon Islands, data gathered through mixing household survey and free-listing interviews, and
518 statistically analysed using multinomial logit models, provided insight into inter- and intra-
519 community perceptions. Unexpected findings include a low (20%) perception of reductions in fish
520 catches despite documented declines, among a population that has a high dependence on and use
521 of the sea and detailed and rich knowledge of the marine environment. Perceptions of change were
522 strongly linked to the community in which the respondent lived, yet there were also high variations
523 in perceptions of environmental change within communities and between communities in a
524 particular locale. Gender was a significant predictor of variation, yet gender also operated differently
525 between agricultural and fishery system contexts. This complicated picture of similarity and variation
526 in perceptions of environmental change inevitably intersects with social, cultural and power
527 relations, and has particular consequences for those who look to the community scale as a venue for
528 fair adaptation. Community perceptions are relied on in community-based adaption to identify local
529 manifestations of environmental change. Yet, in Solomon Islands, we find that significant
530 environmental change is under reported in communities, while variations in perception are not
531 always easily related to commonly assumed fault lines of vulnerability, such as gender. If
532 community-based adaptation is to prioritise the interests of the most vulnerable through
533 participation, then appreciation of and approaches to analyse heterogeneity within and between
534 communities will have to extend to include perceptions of change.

535 Acknowledgements

536 The authors would like to extend their sincere appreciation to all those who engaged in the research
537 activities as part of the project: The Pacific Adaptation Strategy Assistance Program in Solomon
538 Islands – Building social and ecological resilience to climate change in Roviana, Solomon Islands,
539 funded by the Department of Climate Change and Energy Efficiency within the Australian

540 Government. The production of the current manuscript was also supported by the CGIAR Research
541 Programs on: Climate Change, Agriculture and Food Security (CCAFS); and Aquatic Agricultural
542 Systems (AAS) and British Academy GCRF Sustainable Development grant GF160008 (Equitable
543 Resilience in Local Institutions). Thank you to Rodi Maebule and the team at the Roviana
544 Conservation Foundation for their assistance, and most importantly, the men and women from the
545 communities in Roviana, Vonavona and Marovo lagoons, who gave their time to share their insights
546 and experiences, their homes and food with us.

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